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Cushing

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[54] **TIMER MECHANISM WITH IMPROVED INTERVAL ACCURACY**

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[73] Assignee: **General Electric Company**, Louisville, Ky.

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[51] **Int. Cl.**[3] **H01H 43/10**; F16H 5/40; F16H 3/74

[52] **U.S. Cl.** ..... **200/38 R**; 200/38 B; 74/2; 74/3.52

[58] **Field of Search** ..... 74/2, 3.52, 3.54, 567, 74/568 T, 569; 200/38 R, 38 B, 38 BA, 38 C, 38 CA, 39 R, 39 A

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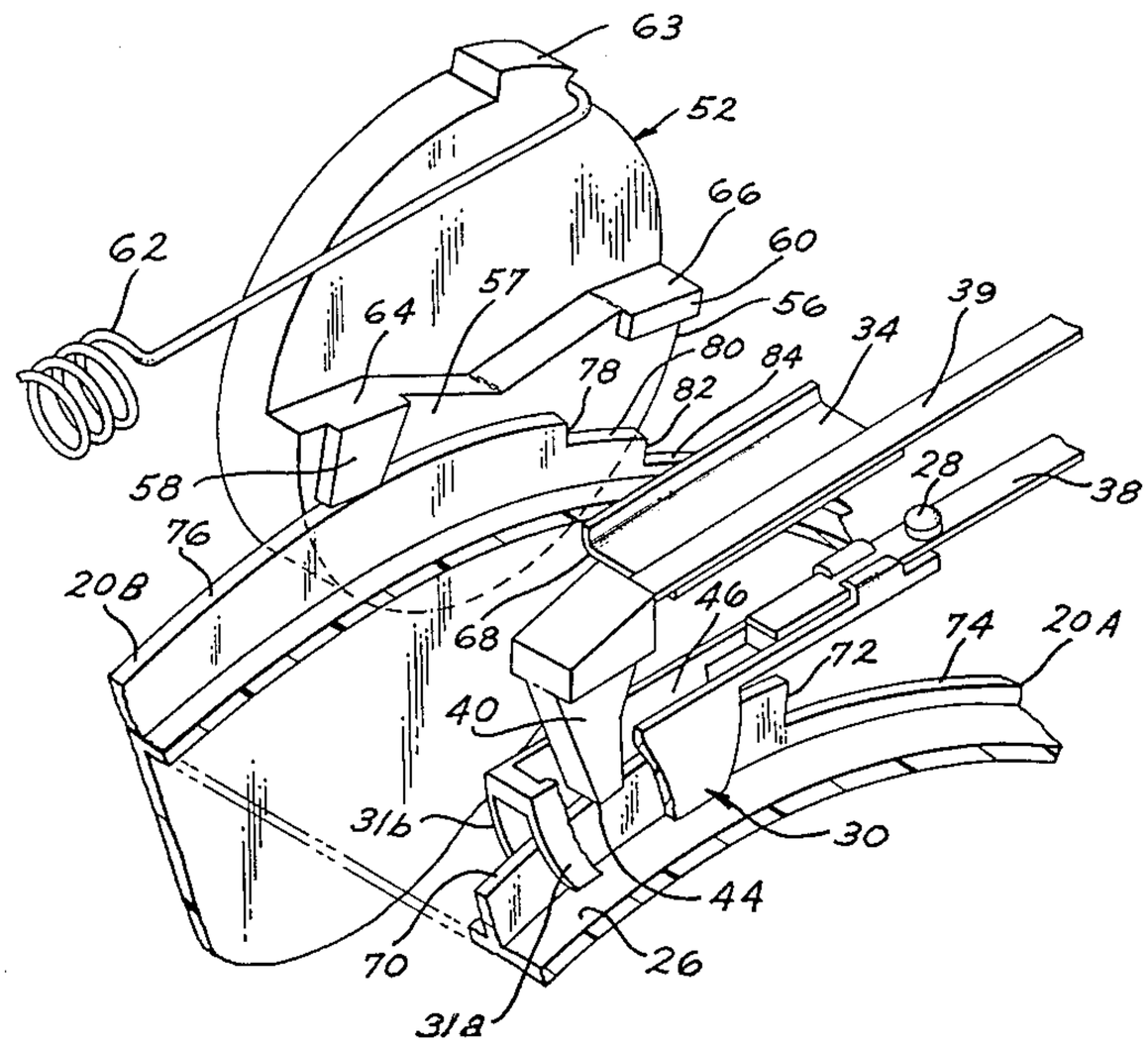
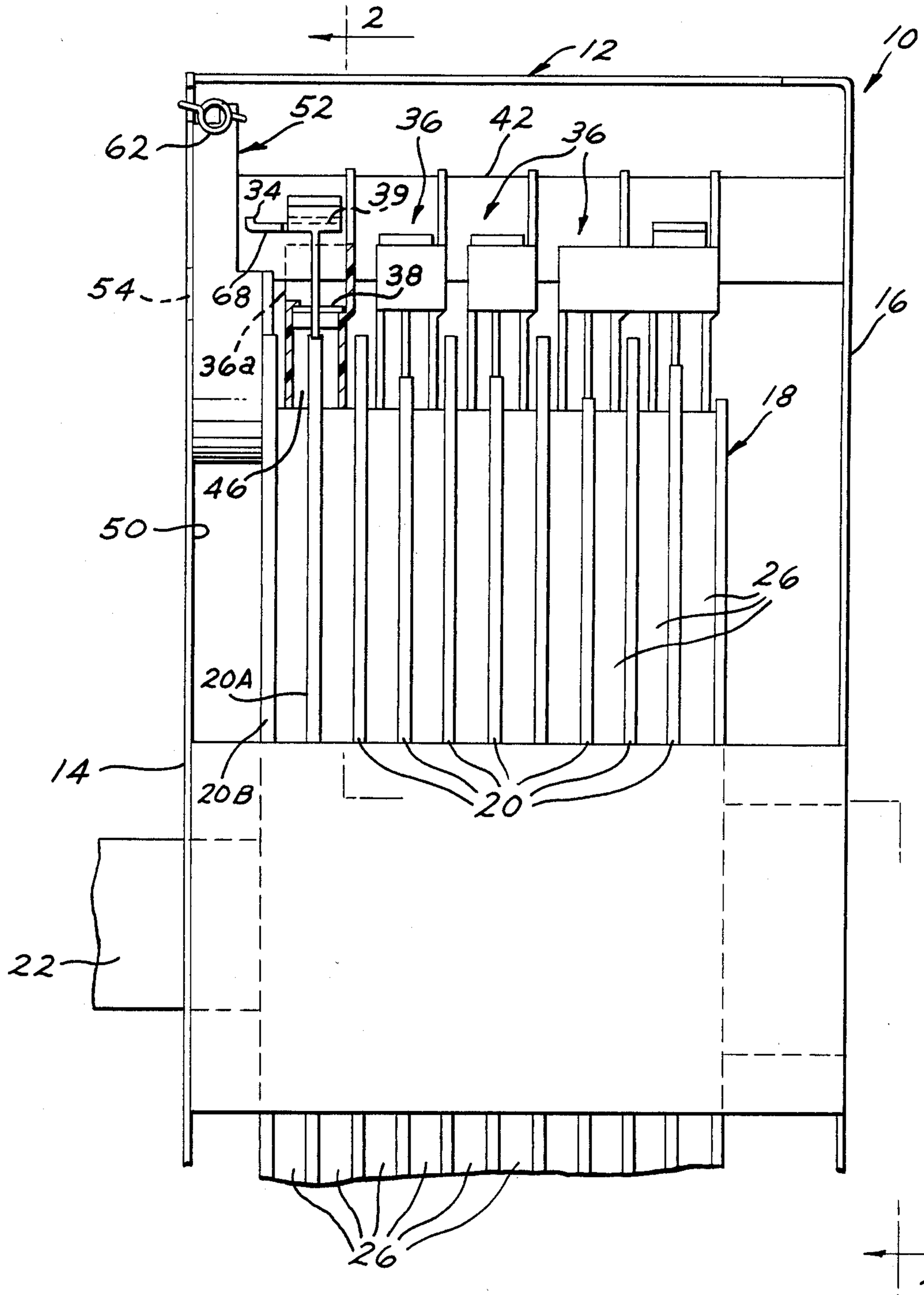
[57] **ABSTRACT**

A timer comprising a driven control cam having a first and second cam track. First and second resilient arms carry opposing contacts and the second arm has a lateral projection in the direction of the second cam track. A cam following member extending between the second arm and first cam track is biased into cam-following engagement with the first cam track by the second arm. A spring biased pivotal rocker arm having at one end a cam follower portion and at the other end a lifter portion. During rotation of the control cam, the cam following member and first cam track are operative to prevent closing the contacts. The cam following member and firt cam track further being operative to release the cam following member from the first cam track and close the contact. The rocker arm and second cam track being operative to pivot the rocker arm so the lifter portion engages the lateral projection of the second arm and opens the contacts. In addition, there is a mechanism to reset the time for subsequent cycling as mentioned above.

7 Claims, 8 Drawing Figures

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36a
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20B
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FIG. 1

FIG. 2

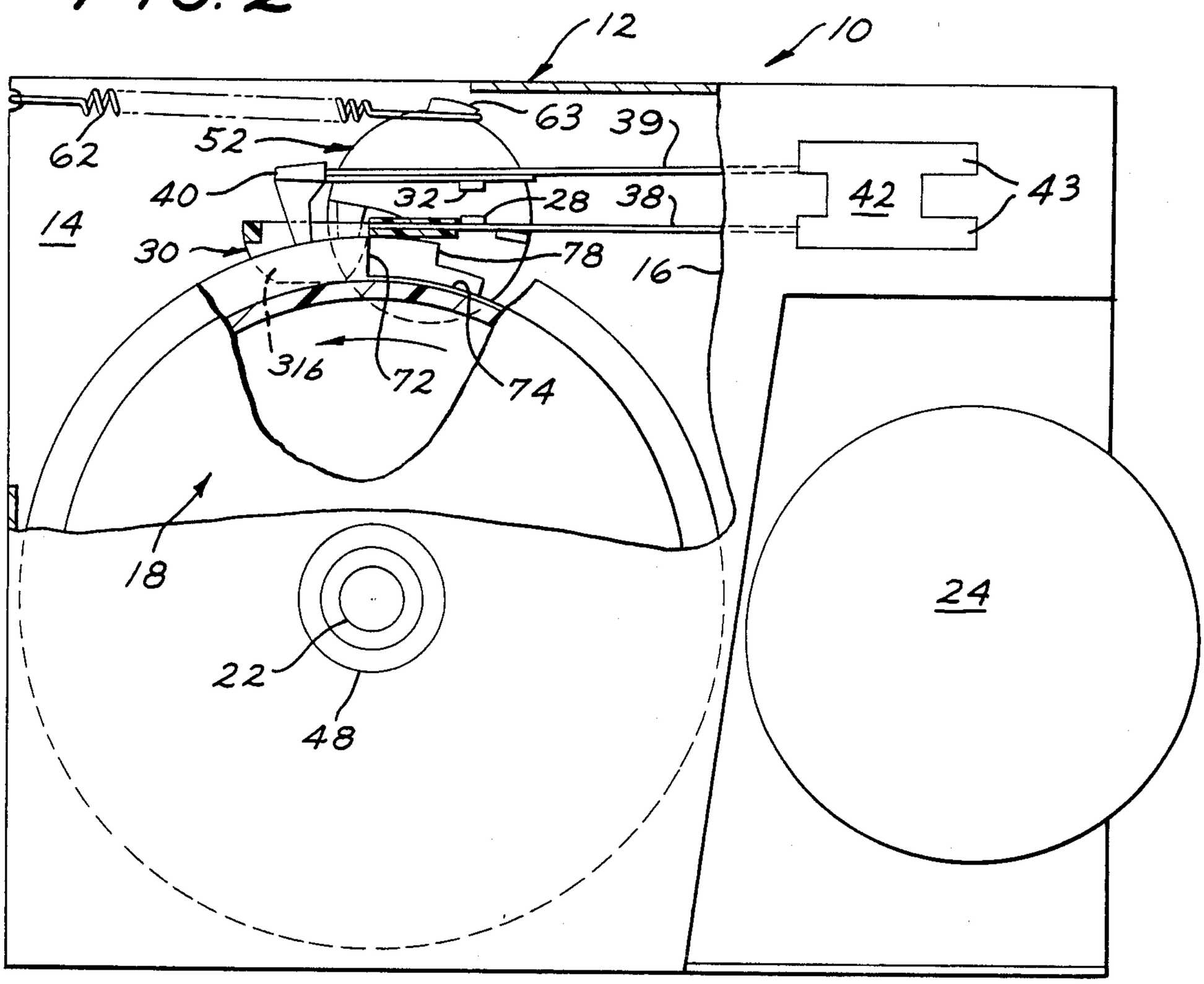
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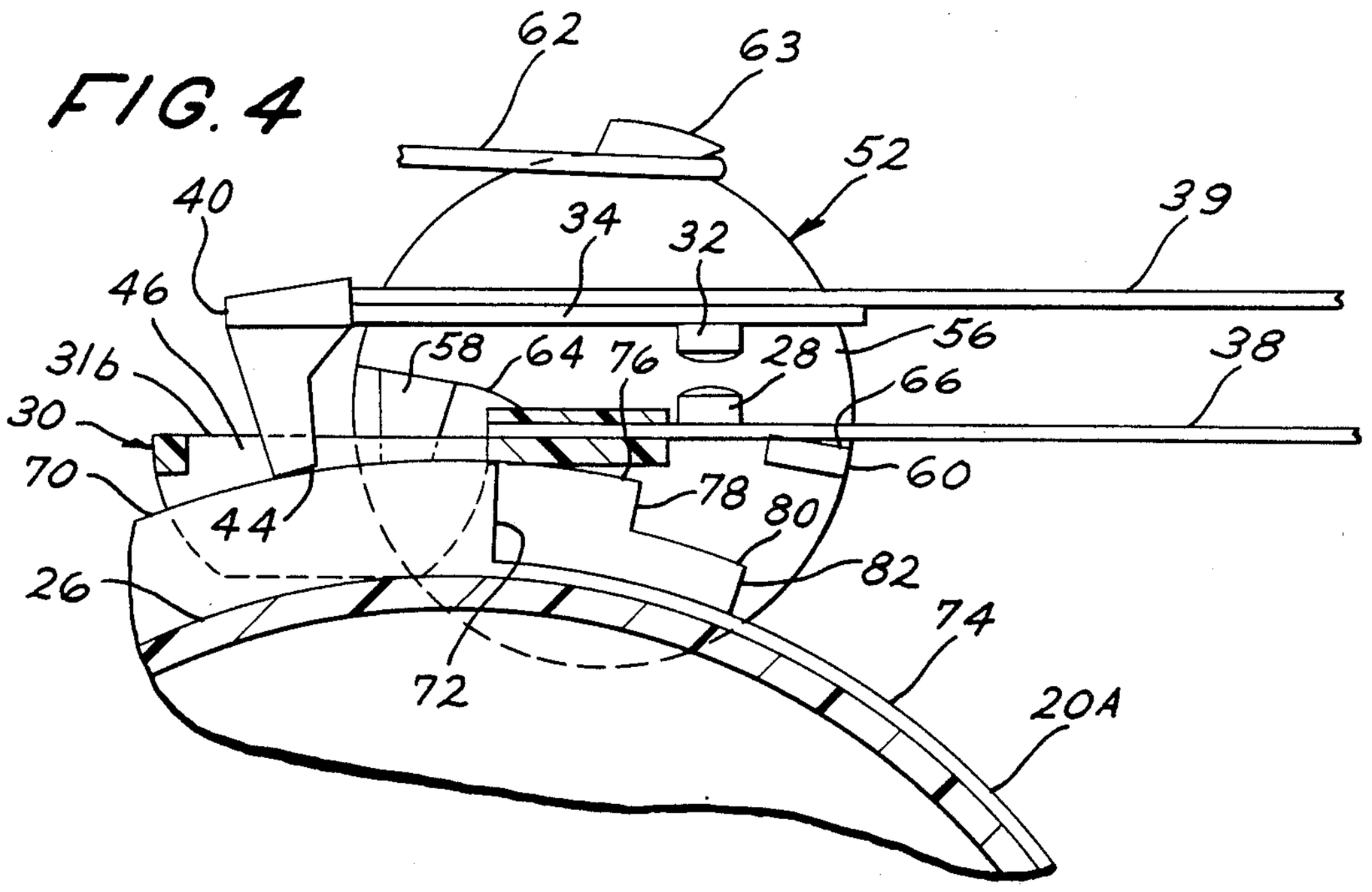
FIG. 4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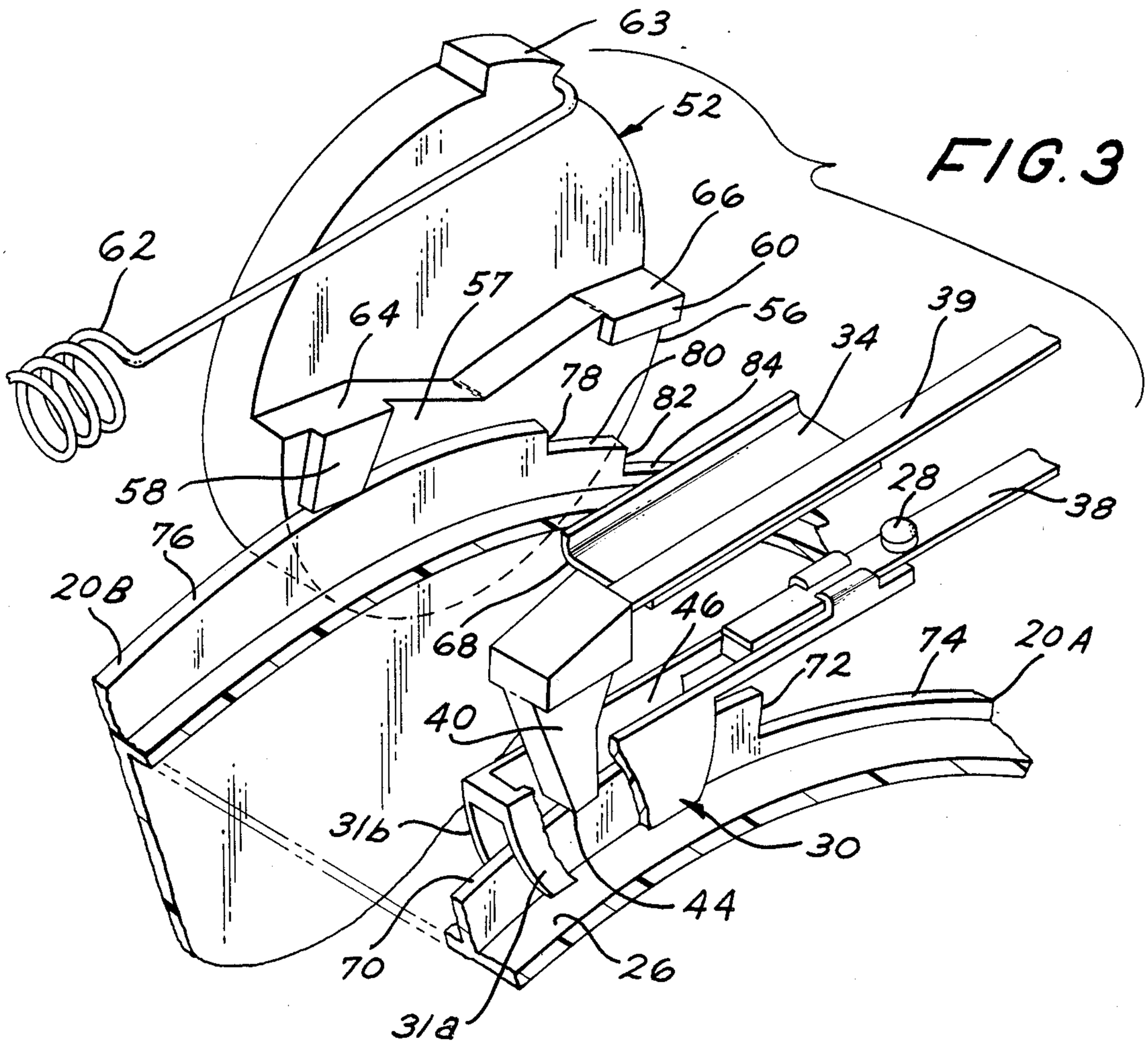
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FIG. 3

FIG. 5

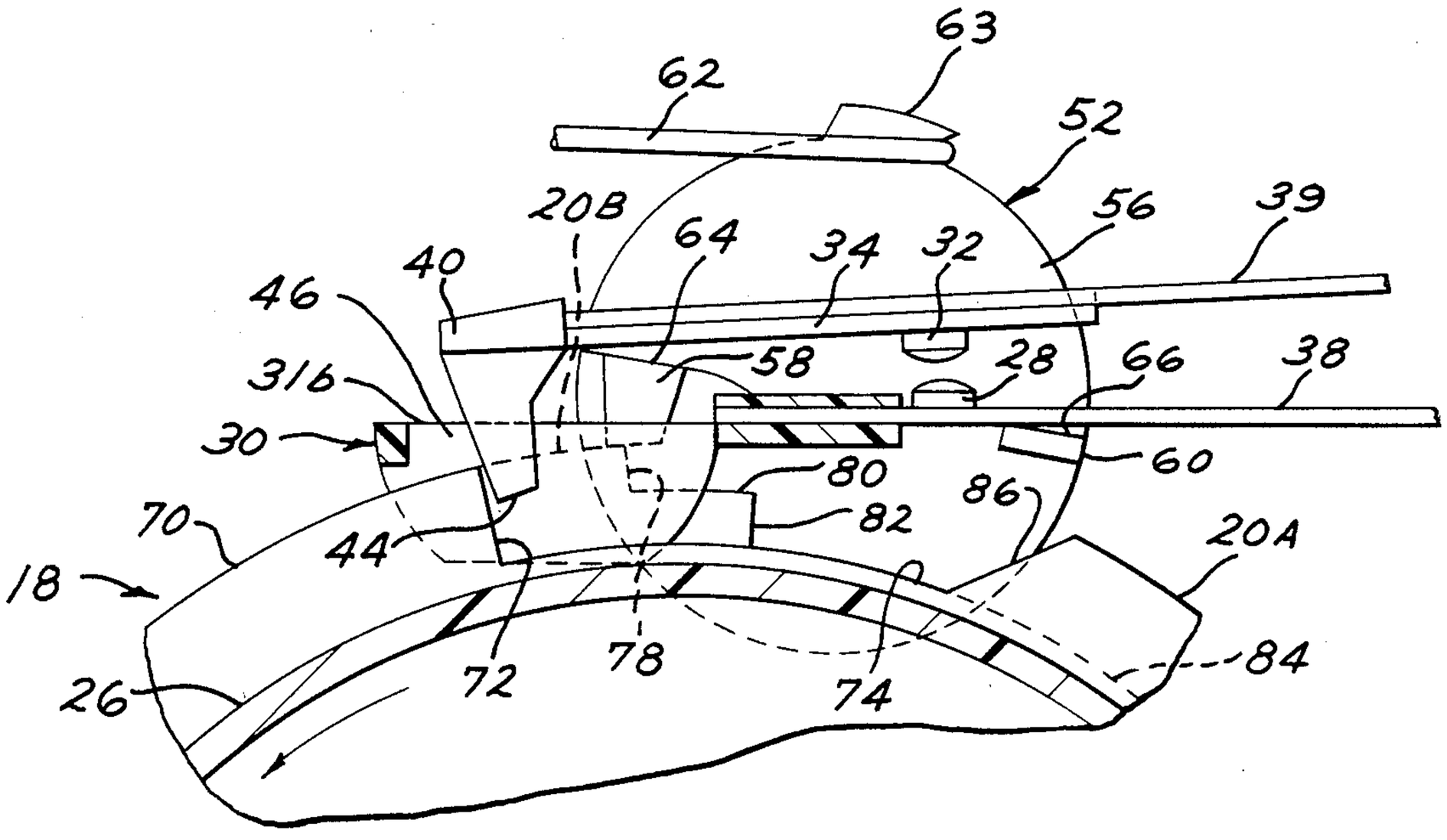
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FIG. 6

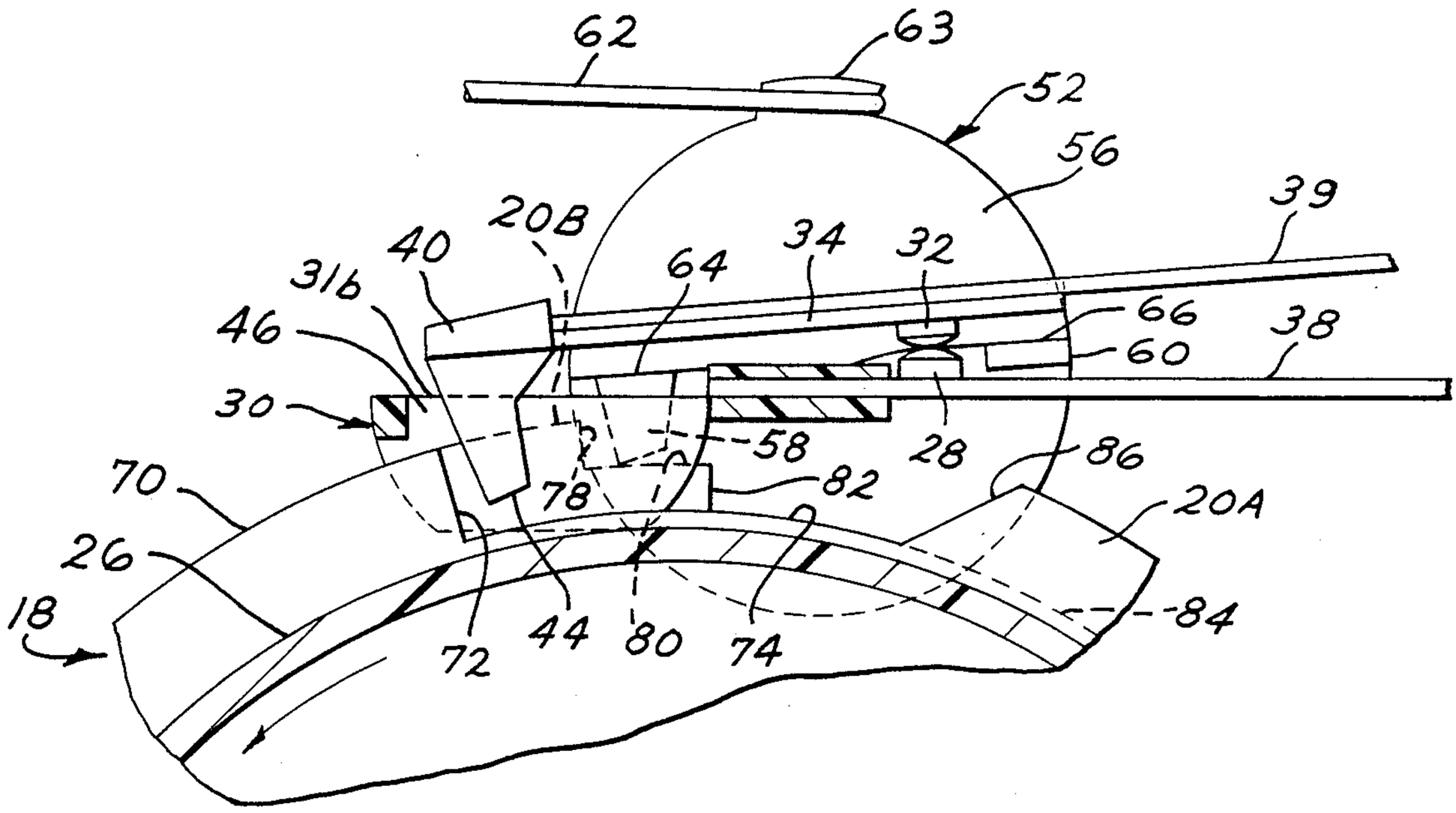
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FIG. 7

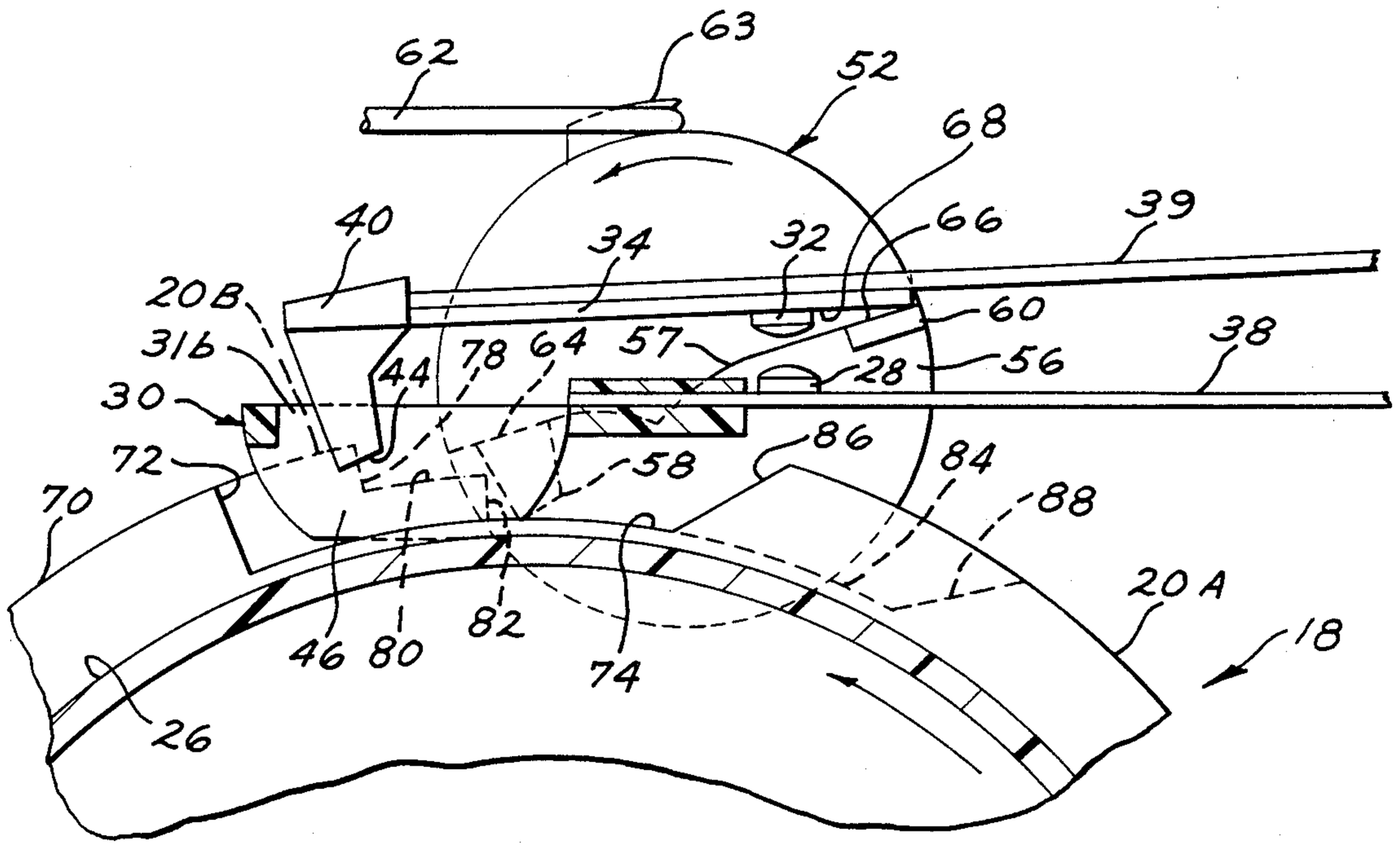
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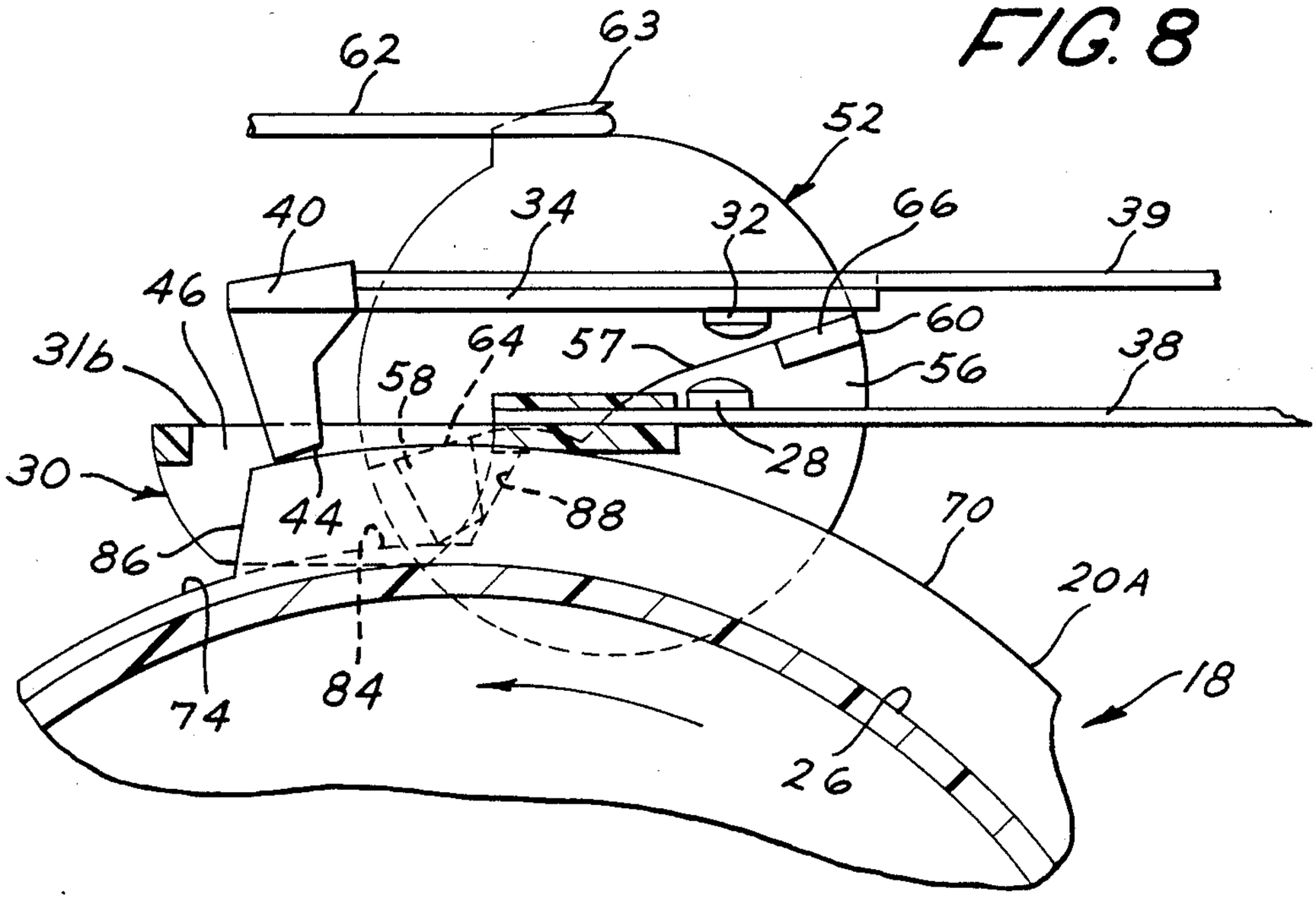
FIG. 8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TIMER MECHANISM WITH IMPROVED INTERVAL ACCURACY

BACKGROUND OF THE INVENTION

Modern automatic washing appliances such as dishwashers and clothes washing machines commonly employ electromechanical timers for controlling various cyclical appliance operations. Typically, timing accuracy is subject to relatively high tolerance variations. For appliances employing time-controlled fill cycles, high tolerance variations can result in excess water usage beyond that required for satisfactory washing performance. For example, on a 78 minutes per revolution timer cam such as typically employed in a dishwasher, the fill time interval may have up to a plus or minus 8 seconds fill time variation because of the many interacting tolerances in the timer. Nominal dishwasher appliance fill flow rates are on the order of 1.75 gallons/minute. At such rates, a time variation of plus or minus 8 seconds results in a variation of plus or minus roughly 2 pints of water during each fill cycle. For a dishwasher having 6 fill cycles for each load of dishes, the variation in total water usage per load is on the order of plus or minus roughly 1.5 gallons.

One technique known in the art for improving the accuracy of such timers is to employ a drop-to-start, drop-to-stop arrangement. In such an arrangement each resilient contact arm carries a cam follower biased against the control cam track. The control switch is made when the first cam follower drops and opens when the second cam follower drops. Such an approach eliminates the rise portion of the track profile and the gap between contact arms and the relative positioning of cam and switch block as sources of tolerance variations. However, even with this double drop approach, positioning of each cam follower on its corresponding contact arm and the relative positioning of the contact arms themselves remain as significant sources of tolerance variations.

In order to reduce water usage in washing appliances such as dishwashers, an electrical mechanical timer of relatively simple construction which provides improved accuracy capability, particularly for short intervals, is needed.

By this invention there is provided an improved electromechanical timer for washing appliances which improves the timing accuracy for short intervals.

SUMMARY OF THE INVENTION

The invention provides an electromechanical timer with improved means for controlling relatively short intervals, such as fill time intervals for washing appliances, with greater accuracy than conventional electromechanical timers. In accordance with one aspect of the invention, the timer includes a mechanism comprising a control cam having a first and second cam track with the second cam track having three arcuate segments of progressively shorter fixed radius lengths defining a three step cam track profile. Drive means are provided for rotating the control cam about an axis and switch means comprising first and second resilient arms carry opposing contacts and extend generally adjacent the first cam track and the first arm extending between the second arm and the first cam track and the second arm having a lateral projection in the direction of the second cam track. The cam following member extending between the second arm and first cam track is biased into a cam-following engagement with the first cam track by the second arm.

A rocker arm having at one end a cam follower portion and at the other end a lifter portion has a pivot point between the ends thereof and is spring biased to force the cam follower portion into cam-following engagement with the second cam track. During rotation of the control cam, the cam following member and first cam track are operative to prevent closing the contacts when the rocker arm cam-follower portion is riding on the arcuate segment having the longest radius length. The cam following member and first cam track are also operative to release the cam following member from the first cam track and support the first arm on the rocker arm cam follower portion and prevent closing the contacts when the rocker arm cam follower portion is riding on the arcuate segment having the longest radius length. The cam following member and first cam track further being operative to release the cam following member from the first cam track and close the contact when the rocker arm cam follower portion is riding on the arcuate segment having the second longest radius length. The rocker arm and second cam track being operative to pivot the rocker arm when the cam follower portion is riding on the arcuate segment having the shortest radius length and the lifter portion engages the lateral projection of the second arm and opens the contacts. In addition, there is means to reset the timer for subsequent cycling as mentioned above. By this arrangement instantaneous and precise making and breaking of the contacts respectively is achieved to provide timer interval accuracy.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is side elevational view of an electromechanical timer embodying the present invention with portions cut away to show the internal structure of the timer.

FIG. **2** is a front view taken along lines **2—2** of FIG. **1**.

FIG. **3** is a perspective view of a portion of the electromechanical timer of the present invention.

FIG. **4** is a partial view of the timer of FIG. **2** enlarged to show the first stage of the timer mechanism operation.

FIG. **5** is a partial view of the timer of FIG. **2** enlarged to show the second stage of the timer mechanism operation.

FIG. **6** is a partial view of the timer of FIG. **2** enlarged to show the third stage of the timer mechanism operation.

FIG. **7** is a partial view of the timer of FIG. **2** enlarged to show the fourth stage of the timer mechanism operation.

FIG. **8** is a partial view of the timer of FIG. **2** enlarged to show the fifth stage of the timer mechanism operation.

DETAILED DESCRIPTION

Referring now to FIGS. **1**, **2** and **3**, the present invention is illustratively embodied by electromechanical timer **10**. Structural support for timer **10** is primarily provided by frame **12** including a front plate **14** and a rear plate **16**. A control cam **18**, having a plurality of circumferential edge control cam surfaces or tracks **20** on its periphery, is formed integrally with a control cam-carrying shaft **22** which is rotatably mounted to

frame **12**. Control cam **18** is rotatably driven by driving means comprising a conventional timer motor **24** coupled to control cam **18** by a chain of gears (not shown) in a conventional manner well known in the art. A plurality of cam-actuated control switches designated generally **36** are suitably secured to frame **12** by a terminal block **42**. Each one of switches **36** comprises a pair of contact arms, each comprising a first arm **38** and a second arm **39** which are disposed in generally tangential relationship to the cylindrical control cam **18**. The contact arms extend from a terminal block **42** for actuation by control cam **18**. Corresponding contacts **43** project from the opposite side of block **42** for electrically connecting the switches to external circuitry. Each contact arm carries a cam follower arranged for cam-following engagement with control cam tracks **20**. Control cam tracks **20** are contoured to provide the desired sequential switch actuation. A timer control knob **48** is suitably mounted to that portion of shaft **22** extending outwardly through front plate **14** to permit user manipulation of the timer.

The timer structure and operation described thus far is typical of electromechanical timers well known in the art. Such timers are subject to fairly high tolerance variations in controlling time intervals. For example, for a 78 minute per revolution timer cam, such as is representative of timers used for domestic washing appliances, a 60 second fill time interval may have a plus or minus 8 second variation.

While such tolerances do not adversely affect satisfactory washing performance, it does adversely impact upon water usage. In order to minimize water usage, thereby reducing the amount of energy consumed in heating such water, it is desirable to provide an accurate means for controlling fill time intervals. This invention is directed to an improved cam-actuated switch arrangement which provides significantly improved accuracy for the relatively short time intervals associated with typical appliance fill cycles, but yet is of relatively simple and inexpensive construction.

The improved cam actuated switch arrangement involves utilizing two of the cam tracks **20**, designated **20***a* and **20***b*, which are adjacent to each other and located near the front plate **14** at the extreme end of the control cam. Cam tracks **20***a* and **20***b* are spaced parallel to each other and rise or project upwardly from the cylindrical base portion **26** of the control cam **18**. The switch assembly **36***a* has a first resilient arm **38** with a contact **28** on its upper surface and a bifurcated cam follower portion **30** at the front end which rides on the upper surface of the cyclindrical base portion **26** of the control cam **18**. The legs **31***a* and **31***b* of the bifurcated cam follower portion **30** straddle cam track **20***a* to confine the cam follower portion **30** against lateral movement whereby the cam-follower is kept on its associated cam. First arm **38** is resilient and is arranged to bias or urge the bifurcated cam follower portion **30** downwardly in contact with the cylindrical base portion **26**.

The switch assembly **36***a* also has located immediately above the first arm **38** a second arm **39** which is biased downwardly in the direction of the first arm **38**. The second arm **39** has a lateral projection member **34** that extends in the direction of the cam track **20***b*. The underneath surface of lateral member **34** has a contact **32** which is in alignment with and opposes contact **28** of first arm **38**. Forward of the lateral projection member **34** is a cam following member **40** which has its lower end **44** in contact with the first cam track **20***a*. It will be noted from FIG. **3** that the cam following member **40** is arranged to pass through an opening **46** of the bifurcated cam follower portion **30** so that it may be urged against and in contact with the first cam track **20***a*. Thus far this cam following arrangement is conventional with the exception of the lateral projection member **34**, however, the structural arrangement and functional operation of how the contacts **28** and **32** of the respective first arm **38** and second arm **39** are made to contact and break contact to achieve the desired switching control will now be discussed.

Adjacent the inside surface **50** of the front plate **14** is a rocker arm **52** mounted on the front plate **14** as by a pivot **54** so that the rocker arm may be rotated back and forth about the pivot. The rocker arm, as shown in the drawings, may be circular in shape and has at its front face **56** a projecting portion **57** having at one end a projecting cam follower portion **58** and at the other end a projecting lifter portion **60** such that the rocker arm **52** has its pivot point between the ends thereof. The rocker arm is spring biased as by means of a coil tension spring **62** one end of which is secured to a lug **63** on the periphery of the rocker arm and the other end to a stationary member such as the timer frame **12** so as to force the cam follower portion **58** into cam following engagement with the second cam track **20***b*. The cam follower portion **58** and lifter portion **60** on the rocker arm **52** underlie the lateral projection member **34** of the second arm **39** of the switch **36***a* as most clearly seen in FIG. **1**. With this arrangement then with sufficient rotation of the rocker arm **52** about its pivot **54** in one direction or the other either the top surface **64** of the cam follower portion **58** or the top surface **66** of the lifter portion **60** will abut against the bottom surface **68** of the lateral projection **34** secured to switch arm **39**.

Cam track **20***a* has an upper track segment **70** against which the lower end **44** of cam following member **40** rides and then a drop **72** with a lower track segment **74**. Thus in the control cam **18** for the first cam track **20***a* the upper track segment **70** has the longest radius length compared to the lower track segment **74**. The rest of the cam track can have whatever configuration is necessary for the operation of the timer in the appliance as desired. The second cam track **20***b* has an upper track segment **76**, a drop **78**, a middle track segment **80**, a drop **82**, and a lower track segment **84**. In the control cam **18** for the second cam track **20***b* the upper track segment **76** would have the longest radius length, the middle track segment **80** would have the second longest radius length and the lower track segment **84** would have the shortest radius length.

With reference to FIGS. **4–8** the sequential operation of the above-described timer will now be discussed. FIG. **4** shows the switch **36***a* arrangement in the first stage wherein the cam following member **40** of the second arm **39** is riding on upper track segment **70** of the first cam track **20***a*. At that time, the cam follower portion **58** of the rocker arm **52** is riding on the upper segment **76** of the cam track **20***b* and the contacts **28** and **32** are out of contact with each other as the first and second arms are essentially parallel to each other. In this stage the cam following member **40** and first cam track **20***a* are operative to prevent closing the contacts when the rocker arm follower portion **58** is riding on the arcuate segment **76** having the longest radius length of cam track **20***b*.

With reference to FIG. **5** when the control cam **18** has been rotated in the direction of the arrow shown in

the figure, the cam following member **40** of the second arm **39** drops off the upper track segment **70** and in doing so the lateral projection member **34** strikes the top surface **64** of the rocker arm **52** and is retained thereon due to the spring bias force of the second arm **39** in the downward direction. It will be noted that the cam following member **40** is held up out of engagement with the lower track segment **74** of the first cam track **20***a*. As can be seen in FIG. **5**, the contacts **28** and **32** are not in contact with each other at this stage. With this arrangement then the cam following member **40** and first cam track **20***a* are operative to release the cam following member from the first cam track segment **70** and support the first arm **38** on the rocker arm and prevent closing the contacts **28** and **32** when the rocker arm cam follower portion **58** is riding on the arcuate segment **76** having the longest radius length.

With reference to FIG. **6** the continued rotational movement of the control cam **18** in the direction of the arrow progresses the first and second cam tracks **20***a* and **20***b* respectively so that the cam follower portion **58** of the rocker arm **52** drops off the drop **78** in cam track **20***b* and comes into contact with the middle segment **80**. The continued bias force of the second arm **39** lowers the arm toward the first arm **38** and allows the contacts **28** and **32** to immediately close. In this position it will be noted that the cam following member **40** of the second arm **39** is still out of contact with the lower track segment **74** of the first cam track **20***a*. In this stage the cam following member **40** and first cam track **20***a* are operative to release the cam following member from the first cam track and close the contacts with the rocker arm cam follower portion riding on the arcuate middle track segment **80** having the second longest radius length.

With reference to FIG. **7** the continued rotation of the control cam **18** in the direction of the arrow causes the cam follower portion **58** of the rocker arm **52** to fall off the second drop **82** and ride on the lower track segment **84** and in doing so the coil tension spring **62** rotates the rocker arm **52** about its pivot **54** in a counterclockwise direction as viewed in FIG. **7** as shown by the arrow at the top of the rocker arm. This rotational movement of the rocker arm **52** causes the upper surface **66** of the lifter portion **60** to engage the bottom surface **68** of the lateral projection member **34** extending from the second arm **39** and overlying the lifter portion **60** and by sufficient spring force raises the second arm **39** upwardly so that the contacts **28** and **32** are separated and out of contact with each other. By this arrangement the rocker arm **52** and second cam track **20***b* are operative to pivot the rocker arm when the cam follower portion is riding on the arcuate lower track segment **84** having the shortest radius length and the lifter portion **60** engages the lateral projection member **34** of the second arm **39** and opens the contacts. Thus far the contacts have been closed and opened and at this stage the timer needs to be reset for subsequent cycling as described above.

With reference to FIG. **8** the first stage in resetting the timer is to provide for an upwardly directed ramp **86** in the first cam track **20***a* so that rotational movement of the control cam **18** in the direction of the arrow will cause the cam following member **40** of the second arm **39** to ride up the inclined ramp **86** and ride on the upper segment **70** of the first cam track **20***a*. Resetting of the timer continues with rotation of the control cam **18** by having the cam follower portion **58** of the rocker arm **52** engage an upwardly directed ramp **88** provided on the second cam track **20***b* so that the cam follower portion **58** is caused to ride up the ramp **88** and in doing so overcomes the spring tension provided by the coil tension spring **62** and rotates the rocker arm **52** in a clockwise direction as shown in FIG. **8** and the cam follower portion **58** will be riding on the upper track segment **76** thus restoring the timer to the position shown in FIG. **4** to complete the resetting of the timer.

By the foregoing timer arrangement and operation it will be understood that the actuation of the switch by the contacts **28** and **32** being quickly engaged and quickly disengaged allows for very precise timing of the cycle because the contacts make contact by an instantaneous drop of the cam follower and the contacts are disengaged also by an instantaneous drop of the cam follower member of the rocker arm.

While specific embodiment of the invention has been illustrated and described herein, it is realized that numerous modifications and changes will occur to those skilled in the art. It is therefore to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit and scope of the invention.

What is claimed is:

1. A timer comprising:

a control cam having a first and second cam track;

said second cam track having three arcuate segments of progressively shorter fixed radius lengths defining a three step cam track profile;

drive means for rotating the control cam about an axis;

switch means comprising first and second resilient arms carrying opposing contacts and extending generally adjacent said first cam track, said first arm extending between said second arm and said first cam track and said second arm having a lateral projection member in the direction of the second cam track;

a cam-following member extending between said second arm and said first cam track and biased into cam-following engagement with said first cam track by said second arm;

a rocker arm having at one end a cam-follower portion and at the other end a lifter portion, said rocker arm having a pivot point between the ends thereof and spring biased to force the cam-follower portion into cam-following engagement with the second cam track;

said cam-following member and first cam track being operative to prevent closing the contacts when said rocker arm cam-follower portion is riding on the arcuate segment having the longest radius length;

said cam-following member and first cam track being operative to release the cam-following member from the first cam track and support the first arm on the rocker arm and prevent closing the contacts when said rocker arm cam-follower portion is riding on the arcuate segment having the longest radius length;

said cam-following member and first cam track being operative to release the cam-following member from the first cam track and close the contacts when said rocker arm cam-follower portion is riding on the arcuate segment having the second longest radius length;

said rocker arm and second cam track being operative to pivot the rocker arm when the cam follower portion is riding on the arcuate segment having the

shortest radius length and the lifter portion engages the lateral projection member of the second arm and opens the contacts; and

means to reset the timer for subsequent cycling.

2. The timer of claim 1 in which the control cam is cylindrical with the cam tracks axially spaced along the cylinder and the resilient arms of the switch means are disposed in generally tangential relationship to the cylindrical control cam.

3. The timer of claim 1 in which the pivotal rocker arm is circular and is spring-biased by a coil tension spring, one end of which is secured to the periphery of the rocker arm and the other end to a stationary member.

4. The timer of claim 1 wherein the first and second cam tracks are adjacent each other and located at one extreme end of the control cam.

5. The timer of claim 1 wherein the lateral projection member on the second arm carries the contact for that arm.

6. The timer of claim 1 including a frame that has a front plate to which the rocker arm is pivotally attached.

7. The timer of claim 1 in which the first arm has a bifurcated cam follower portion with an opening and legs that straddle the first cam track and the cam-following member of the second arm extends through the opening of the bifurcated cam follower portion of the first arm and engages the first cam track.

* * * * *